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COMMONWEALTH OF KENTUCKY  
NATURAL RESOURCES AND ENVIRONMENTAL PROTECTION CABINET  
DEPARTMENT FOR ENVIRONMENTAL PROTECTION  
DIVISION OF ENVIRONMENTAL SERVICES  
100 SOWER BOULEVARD  
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FRANKFORT, KY 40601

RECEIVED

AUG 22 1995

Permit Review Branch

August 13, 1995

Division of Environmental Services  
Report Number: A37-00001  
Sample Number: 9502218

To: Division of Water  
14 Reilly Road  
Frankfort, Kentucky 40601

Re: Chenoweth Run

Attn: David Leist

County: Jefferson

Facility:

Collected by: David Leist

Date: 07/11/95 Time: 1225

Delivered by: Skip Call

Date: 07/12/95 Time: 0949

Received by: Polly Baker

Date: 07/12/95 Time: 0949

Sample Matrix: Water

Collection Method: Grab

Sample Identification: CR1 - Chenoweth Run at Seatonville Road

REPORT OF ANALYSIS

TOTAL CONSTITUENTS

Aluminum  
Antimony  
Barium  
Beryllium  
Cadmium  
Calcium  
Chromium  
Cobalt  
Copper  
Iron  
Magnesium  
Manganese  
Molybdenum  
Nickel  
Potassium  
Silver  
Sodium  
Strontium  
Thallium  
Tin  
Vanadium  
Zinc  
Arsenic  
Mercury

CONCENTRATION

ND @ 0.056 mg/L  
ND @ 0.028 mg/L  
0.043 mg/L  
ND @ 0.001 mg/L  
ND @ 0.006 mg/L  
58.2 mg/L  
ND @ 0.016 mg/L  
ND @ 0.013 mg/L  
0.008 mg/L  
0.197 mg/L  
23.6 mg/L  
0.027 mg/L  
ND @ 0.009 mg/L  
ND @ 0.011 mg/L  
9.70 mg/L  
ND @ 0.002 mg/L  
50.4 mg/L  
0.194 mg/L  
ND @ 0.048 mg/L  
ND @ 0.015 mg/L  
ND @ 0.004 mg/L  
0.016 mg/L  
ND @ 0.002 mg/L  
ND @ 0.0001 mg/L



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TOTAL CONSTITUENTS

Selenium

CONCENTRATION

ND @ 0.002 mg/L

ND = Not Detected

This report has been prepared and reviewed by personnel within the Division of Environmental Services. It has been approved for release.

  
William E. Davis, Director  
Division of Environmental Services

***APPENDIX II. MSD/USGS CHENOWETH RUN  
PROJECT PROPOSAL***

*(re-printed with permission from MSD and the USGS)*

## PROJECT PROPOSAL

### HYDROLOGIC MODELING OF THE CHENOWETH RUN WATERSHED, JEFFERSON COUNTY, KENTUCKY

U.S. Geological Survey  
Water Resources Division  
Kentucky District

November 1995

## INTRODUCTION

The Kentucky District of the U.S. Geological Survey (USGS), Water Resources Division is proposing cooperative development of a computerized watershed-simulation model that can be used for optimizing management decisions relating to water quality and quantity in the Chenoweth Run drainage basin in Jefferson County. The model-development process will require compilation and review of available data and collection of additional data where necessary. These data will be made readily available to other local, state, and federal agencies, as well as concerned citizens.

The data will be used to determine the dominant processes controlling water quality and quantity in the basin, ascertain the rate with which concentrations of key constituents change under different circumstances, and provide a mathematical simulation of these processes using computer-based algorithms. There have been hundreds of modeling applications for this purpose all over the world. These applications have been accomplished for watersheds as small as a few acres and as large as the Chesapeake Bay tributary area, approximately 62,000 square miles. The USGS, in cooperation with the Louisville and Jefferson County Metropolitan Sewer District (MSD), is currently developing such a model for similar purposes in the Beargrass Creek Basin of Jefferson County.

## PROBLEM AND NEED

Changes associated with land-development activities, which are anticipated to increase in this basin in the future, can significantly alter the hydrologic character of a drainage basin. Transformation of open farmlands to housing complexes, golf courses, or commercial and/or industrial areas can adversely affect the quality and quantity of downstream water resources. In addition to Chenoweth Run, there are numerous ponds and small lakes in the basin that can be adversely affected by future development undertaken in the absence of sound land-use and water-management decisions.

Water-quality problems in the Chenoweth Run drainage basin have been reported by USGS (*Water Quality of Selected Streams in Jefferson County, Kentucky, 1988-91*, Evaldi and others; *Yields of Selected Constituents in Base Flow and Stormflow in Urban Watersheds of Jefferson County, Kentucky, 1988-92*, Evaldi and Moore), MSD (*MSD Stream Quality Monitoring Report with 1991/1992 Data*), and Kentucky Division of Water (KDOW). Sources of these problems may include wastewater-treatment plants, agriculture (including livestock), construction activities, stream-bank erosion, lawn care, golf courses, and storm runoff from urban and industrial areas. The KDOW (*Water Quality Study of Floyds Fork, 1991*) reported adverse effects on Chenoweth Run resulting from wastewater effluents. During certain periods of the year, wastewater discharges may dominate streamflow in Chenoweth Run resulting in nutrient-enrichment problems. In 1991, KDOW proposed a moratorium on additional wastewater-treatment facilities in the Chenoweth Run drainage basin. The 1994 *Kentucky Report to Congress on Water Quality*

(KDOW) listed 9 miles of Chenoweth Run as not meeting either aquatic life or swimming uses because of organic enrichment, nutrients, metals, and pathogens discharged in urban runoff and wastewaters.

An improved understanding of the dominant processes controlling water quantity and quality in streams and impoundments in the Chenoweth Run Basin is needed. A hydrologic-modeling tool is needed for assessing the effectiveness of alternative water-resources-management strategies in the Basin.

## OBJECTIVE

The objective of this study is to provide an improved understanding of the hydrology of the Chenoweth Run drainage basin by development and calibration of a comprehensive watershed model for continuous simulation of rainfall-runoff, infiltration and subsurface flow, evapotranspiration, channel hydrology, soil erosion, contaminant wash-off, constituent transport and transformation, and sedimentation and resuspension. The model will simulate processes linking land use to water quantity and quality so as to provide valuable information concerning streamflows and source/transport/fate relations for water-quality constituents. This objective requires: (1) calibration of a hydrologic model that will provide satisfactory prediction of streamflows ranging from base flows to flood flows at key locations in the basin and (2) development of a suitable mass balance budget (loadings) for constituents of interest in the Chenoweth Run Basin.

## BENEFITS

This watershed modeling study will provide MSD an improved ability to make water-resources-management decisions and to develop long-term strategies for improving water quality in the basin. The study results and the calibrated model will be provided to MSD for future application in water-resources management in the Chenoweth Run basin. An improved understanding of and the ability to simulate the key processes controlling water quality and quantity will facilitate evaluation of the effects of various future land-development scenarios and alternative management options. The calibrated model can be used to assist in prioritizing problems in the Chenoweth Run drainage basin and assessing the relative effectiveness of Best Management Practice (BMP) or other options.

Application of a well-documented, tested, and scientifically based watershed model developed and calibrated by the USGS, which has no regulatory or resource-management authority, will provide an objective source of information available to all interested

parties. The calibrated model can be used to test hypotheses concerning basin hydrologic behavior and water-quality conditions. For example, the model may be applied to quantitatively assess the following:

- The effects and contribution of point and nonpoint sources of contamination
- The effects of increased urbanization (with additional paving of pervious areas and clearing of riparian vegetation) on stream base flows and water temperatures, which are critical factors controlling the health of aquatic communities
- The timing and movement of flood flows from various subbasins of Chenoweth Run, which is important for determining the potential effectiveness of stormwater-detention facilities

This study will also provide additional information for regionalization of the model parameter set to the hydrology of Jefferson County and central Kentucky. This will improve MSD's capability to apply such hydrologic models in other basins in Jefferson County.

## APPROACH

This study will be designed to define the relations between present-day land-use activity and water-quality and quantity characteristics. This will be accomplished by applying Geographic Information System (GIS) technology, hydrologic and environmental data collection and analysis, sound ecological theory, and computer modeling codes. Calibration of the continuous watershed model will provide an assessment of how well it simulates those relations.

The continuous watershed model, Hydrologic Simulation Program--Fortran (HSPF) (Bicknell and others, 1993), will be used in this study. This model provides a continuous accounting of soil moisture (antecedent) conditions and thus allows for continuous simulation of the complete flow regime from low to high flow. Some water-quality conditions may be critical during low flows, and the effects of point sources may be most evident during low-flow periods. Maximum constituent loadings, though not necessarily the highest concentrations, often occur during high-flow periods. Thus, continuous modeling of the full range of flow conditions is important for accurate representation of water-quality conditions. Rainfall-runoff simulations and simulation of erosion and wash-off processes provide the basis for nonpoint-source simulation in the basin. Routing of this water and material from the land surface and subsurface to collecting channels and surface streams allows accounting for the fate and transport of materials throughout the hydrologic regime of the basin.

Tasks for implementation of this modeling study are outlined below:

1. **Collect required hydrometeorological data including precipitation, streamflow, and water-quality characteristics.**

Existing hydrometeorological data will be reviewed and utilized to the maximum extent possible for this study. Continuous rainfall and discharge information was collected from 1991-95 at the USGS/MSD flood-hydrograph station on Chenoweth Run in Jeffersontown (stations 03298130 and 03298135). One site in the USGS/MSD stream-monitoring network is located at Chenoweth Run at Gelhaus Lane. Water-quality and streamflow information is being collected in 1995 at several locations in the basin for a KDOW study of the basin.

Field data-collection activities will be required to determine the quantity and physical, chemical, and bacteriological characteristics of streamflow in the basin. Data-collection activities will include discharge measurements, water-quality measurements, water-quality sampling, and gaging-station servicing. Water samples will be collected by use of manual, cross-sectionally integrated sampling techniques and by use of automatic samplers where appropriate. All field activities will be conducted using documented procedures and quality-assurance practices of the USGS.

The proposed continuous-record data-collection network includes stream gages with monitors for water temperature, specific conductance, pH, and dissolved oxygen at two locations (Chenoweth Run at Ruckriegel Parkway and Chenoweth Run at Gelhaus Lane) and at least one rain gage (at or near Chenoweth Run at Ruckriegel Parkway). Rainfall and streamflow will be determined at 5-minute intervals. Temperature, specific conductance, pH, and dissolved oxygen will be measured at 5- to 30-minute intervals.

Stream-water samples will be collected for laboratory analysis in an effort to characterize spatial, flow-related, and seasonal variability of water quality in the basin. Samples will be collected during low, moderate, and high flows. Emphasis will be placed on sampling moderate to high flows, because the greatest variability in stream-water-quality conditions (and consequently the greatest modeling uncertainty) occurs during high flows. Sampling will be conducted during a variety of storm events of differing duration, intensity, and antecedent conditions. Moderate- and high-flow events will be targeted for sampling during the winter, late-spring/early-summer, and late-summer/early-fall time periods.

Stream-water samples may be single discrete samples, one of a series of discrete samples, or a composite of a series of discrete samples. During low flows, single discrete samples will be collected. During storms producing moderate and high flows, a series of discrete water samples will be collected for the duration of the storm hydrograph. Ideally, at least five water samples will be collected over the duration of the hydrograph for a storm event. Streamflow will be measured when samples are collected. The series of discrete samples collected over the storm hydrograph may be analyzed individually to generate observed pollutographs (plots of constituent concentrations over time) and loadographs (plots of constituent loading over time) that provide information on contaminant movement in the basin and storm-event loading. Alternatively, the series of discrete



samples may be composited into a single sample for analysis, which can be used to estimate the mean storm-event constituent concentrations and the storm-event loading. Single, discrete storm-event samples may also be collected to supplement available high-flow information.

Water samples for analysis of constituents of interest will be collected over a 2-year period at four locations on Chenoweth Run (Ruckriegel Parkway, Taylorsville Road, Gelhaus Lane, and Seatonville Road). A limited number of supplemental high-flow samples will ideally also be obtained at Easum Road. The types and number of samples proposed for each location are shown in the table below.

Sampling location (station)	Sample type			
	Storm series	Storm composite	Single, discrete high flow	Single, discrete low flow
Ruckriegel Parkway (03298135)	6	---	---	2
Taylorsville Road (03298140)	---	6	---	2
Easum Road (03298145)	---	---	*	2
Gelhaus Lane (03298150)	6	---	---	2
Seatonville Road (03298160)	---	6	---	2

\* The extent of sampling required at this location will depend on the adequacy of existing data.

MSD laboratory analysis of water samples will include determinations of all routine parameters currently analyzed for the USGS/MSD stream-monitoring network [pH, alkalinity, total dissolved solids, total suspended solids, total volatile suspended solids, biological oxygen demand (BOD), chemical oxygen demand (COD), nitrate nitrogen, nitrite nitrogen, ammonia nitrogen, organic nitrogen, ortho-phosphorus, total phosphorus, fecal *Coliform* and *Streptococcus*]. (Water sampling and analysis of metals and pesticides could be added as future model refinements and enhancements.) Field determinations will include streamflow, air and water temperature, barometric pressure, dissolved oxygen, pH, and conductivity.

Data-collection and laboratory-analysis procedures will be reviewed in accordance with the quality-assurance practices of the USGS to ensure that data quality will be consistent with overall project objectives. Quality-assurance samples will be used to ascertain the precision, variability, bias, and representativeness of the project data.

The water-quality data collected during the 2-year calibration period and the available historical data can be related to stream discharge. These relations, used in conjunction with continuous stream-discharge data, provide a means to estimate constituent concentrations and loadings on a continuous basis. The observed and estimated water-quality information will be compared to model simulations during the model calibration/confirmation process.

Project sampling may be accomplished most effectively by redirection of USGS/MSD resources currently used for routine monitoring of stream-water quality. It is assumed that about 5 sites in the stream-monitoring network located elsewhere in the County will be discontinued following an analysis of the network (see companion proposal titled *Probability-Based Evaluation of the Stream-Monitoring Program*), and resources for the discontinued stations will be redirected to storm sampling for this Chenoweth Run modeling study. Thus, one MSD field person will be presumed available to assist in all project sampling activity.

2. **Collect all available information on point- and nonpoint-contaminant sources including wastewater-treatment plants, industrial discharges, paved areas, construction sites, and chemically treated lawns.**

Literature values are typically used in modeling to estimate contaminant wash-off rates from specific land uses. Observed storm-runoff data and techniques for estimating storm-runoff quality for Jefferson County have been published in previous studies (Evaldi and Moore, 1992; and Evaldi and Moore, 1994). Though not budgeted in this study, sampling of runoff from specific land uses in the basin would improve model accuracy.

3. **Determine basin and channel characteristics needed to parameterize the model including drainage areas, land uses, impervious area, soils characteristics, storm sewers, channel shape and length.**

Detailed data collection and analysis to determine critical basin characteristics may be required to adequately parameterize and calibrate the model. The Natural Resource Conservation Service (NRCS) is available to assist the USGS in determination of selected basin characteristics. Field measurement of soils properties including permeability and water-storage characteristics in the basin would provide valuable information for parameterizing the model. Supplementary project funding for this data-collection effort is being pursued.

4. **Develop, calibrate, and confirm the HSPF model.**

Both the historic and the current data collected during the 2-year sampling period will be used to calibrate and confirm the basin model. Additional confirmation of the model parameter set could be accomplished by extending the data collection beyond 2 years and (or) by parameter application in modeling a nearby, similar basin such as Cedar Creek.

## REPORTS

A USGS Water-Resources Investigations Report will be published that will contain: (1) a basin map showing important hydrologic features; (2) a description of data-collection methods and results; (3) a description of the model development and simulations; and (4) an uncertainty analysis of the model results.

## HUMAN RESOURCES

Hydrologists and biologists familiar with hydrologic data collection and modeling are available in the District to complete the project. Experienced field personnel are available to collect and manage the field data. Technical support will also be provided by the Kentucky District Water-Quality and Surface-Water Specialists, as well as District staff having expertise in specialized areas such as GIS technology. During event-sampling periods, other USGS staff in the Kentucky District may be available to assist in data-collection activities for the project. Other personnel in the District will be assigned as needed to assist the project leaders. The project leaders will coordinate closely with MSD on project execution.

The assistance of MSD personnel will also be needed for project completion. Two-person teams will be needed for much of the collection of field data. It is envisioned that these teams will include both USGS and MSD personnel. It is proposed that the MSD water-quality laboratory perform required sample analyses. Assistance from MSD and/or Louisville and Jefferson County Information Consortium personnel will be needed to provide available GIS coverages for the study area. For the purpose of MSD acquiring an in-house model-application capability, it is assumed that one or more staff from MSD will be available to participate where feasible in the Chenoweth Run model-development process.

## SELECTED REFERENCES

- Bicknell, B.R., Imhoff, J.C., and Kittle, J.L., Jr., 1993, Hydrologic Simulation Program—Fortran, User's Manual for Release 10: U.S. EPA Environmental Research Laboratory, Athens, Ga., EPA/600/R-93-174.
- Evaldi, R.D. and Moore, B.L., 1992, Stormwater data for Jefferson County, Kentucky, 1991-92: U.S. Geological Survey Open-File Report 92-638, 82 p.
- Evaldi, R.D., Burns, R.J., and Moore, B.L., 1993, Water quality of selected streams in Jefferson County, Kentucky, 1988-91: U.S. Geological Survey Water-Resources Investigations Report 92-4150, 177 p.
- Evaldi, R.D. and Moore, B.L., 1994, Techniques for estimating the quantity and quality of storm runoff from urban watersheds of Jefferson County, Kentucky: U.S. Geological Survey Water-Resources Investigations Report 94-4023, 70 p.
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- Kentucky Natural Resources and Environmental Protection Cabinet, Division of Water, 1994: The 1994 Kentucky report to Congress on water quality, 318 p.
- Louisville and Jefferson County Metropolitan Sewer District, 1993: MSD stream quality monitoring report with 1991/1992 data.